

Figure 1a

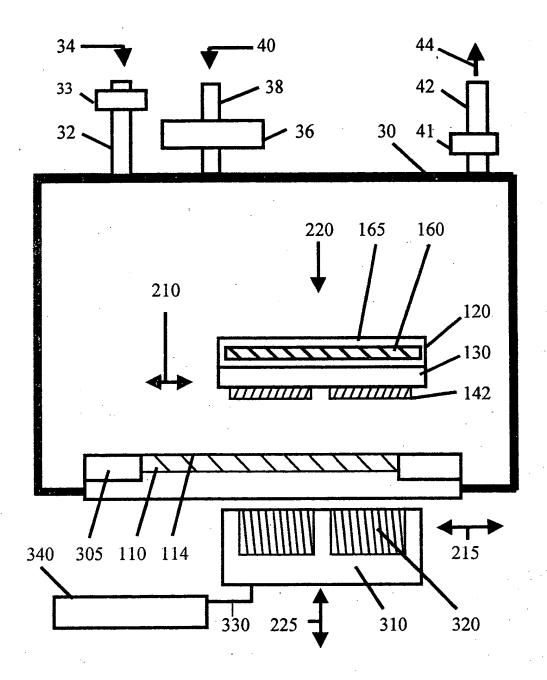


Figure 1b

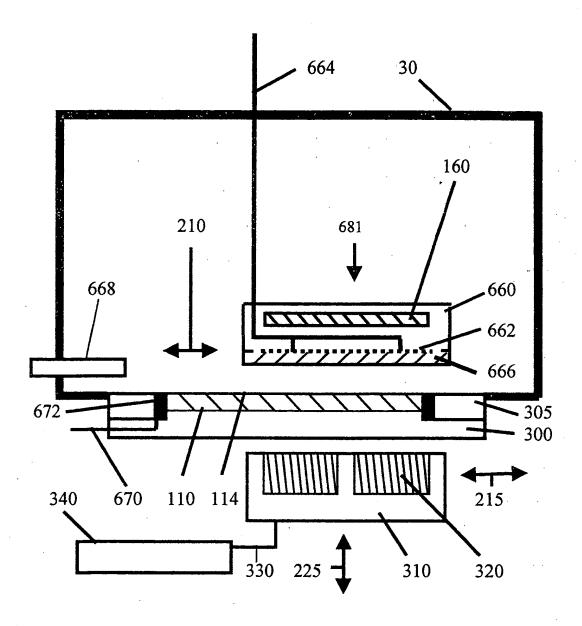


Figure 1c

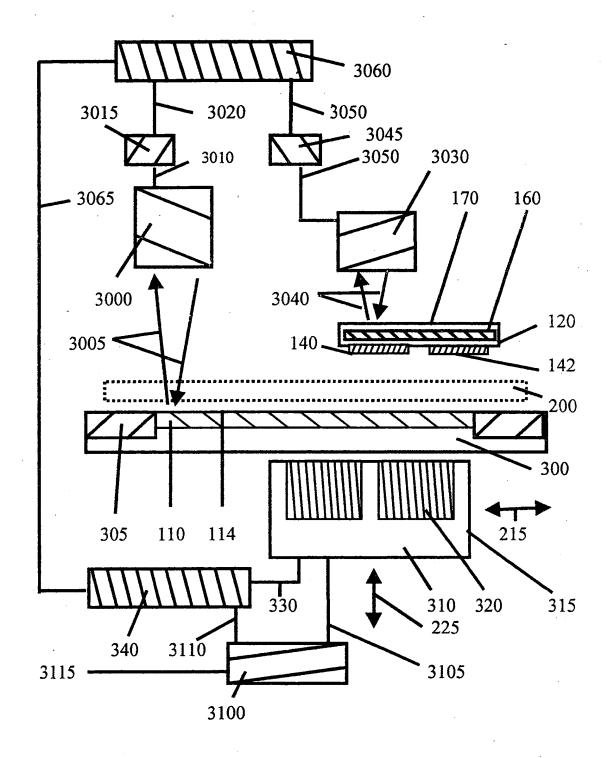


Figure 2

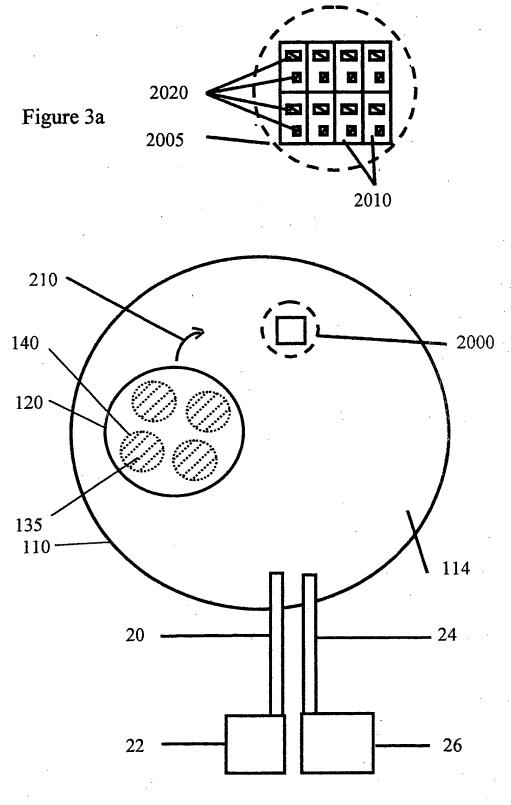


Figure 3

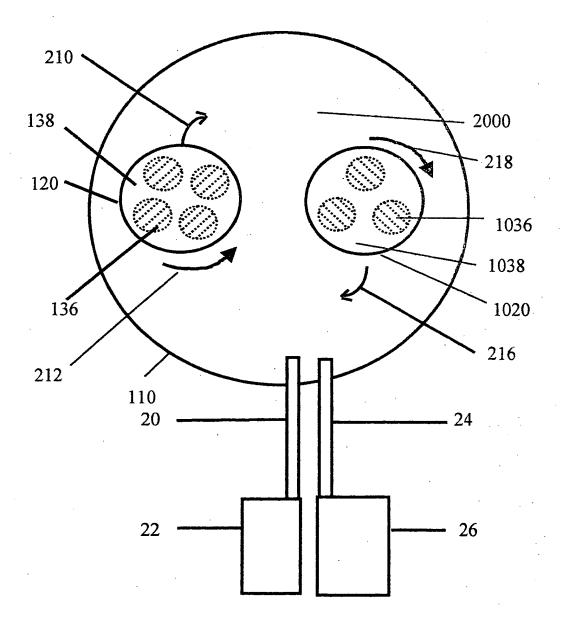


Figure 4

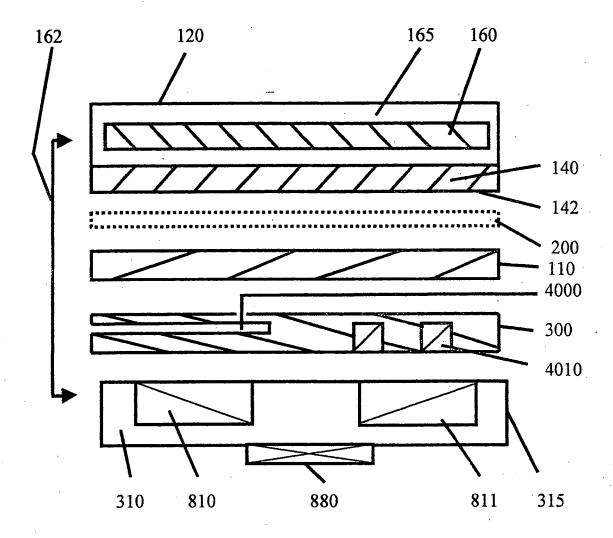
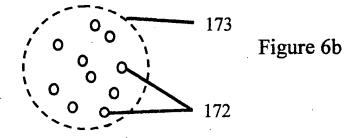


Figure 5



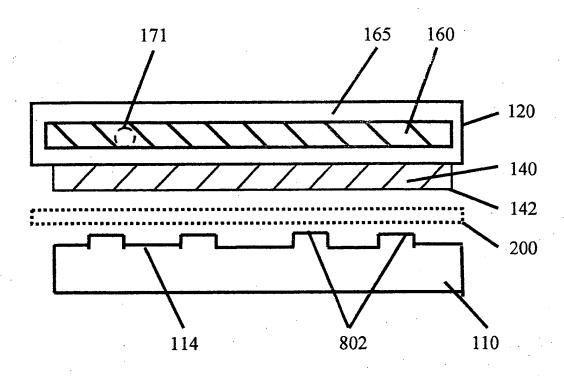


Figure 6

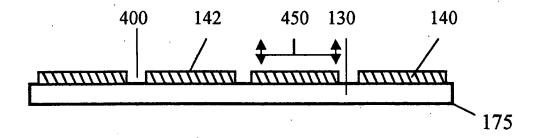


Figure 7a

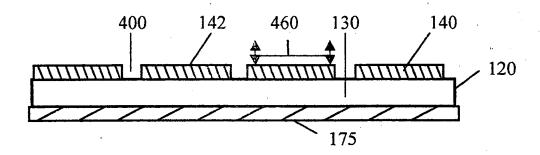


Figure 7b

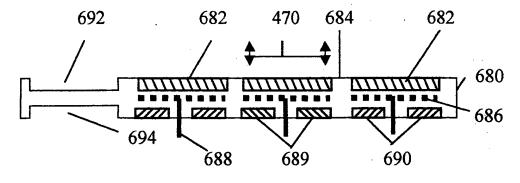


Figure 7c

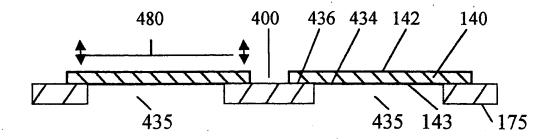


Figure 8a

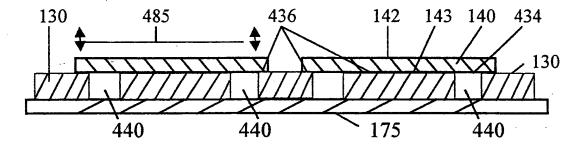


Figure 8b

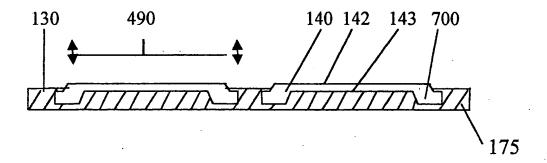


Figure 9a

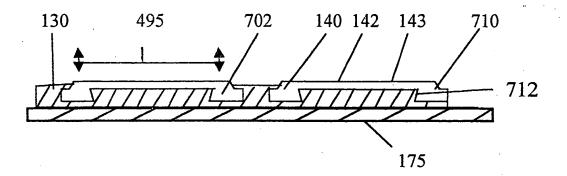


Figure 9b

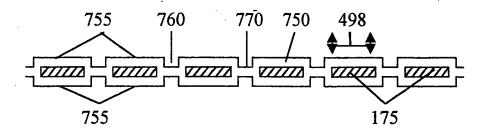


Figure 9c

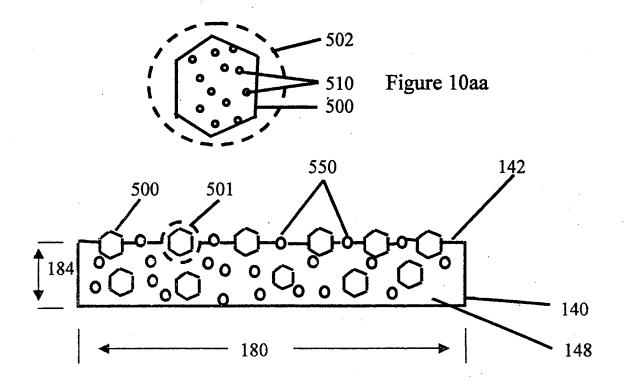


Figure 10a

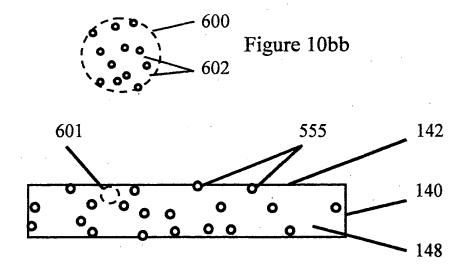


Figure 10b

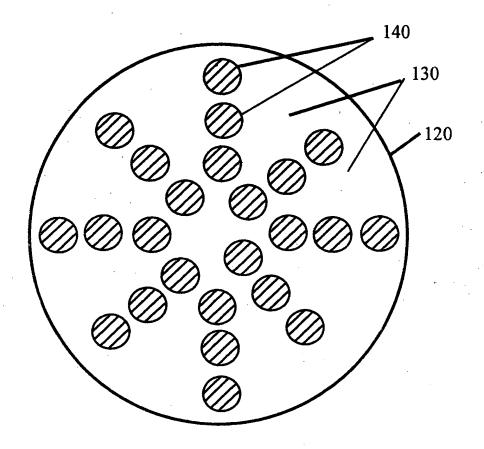


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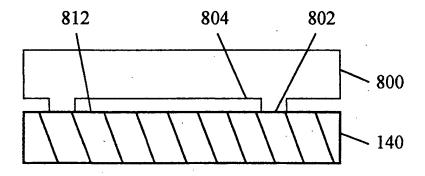


Fig. 12a

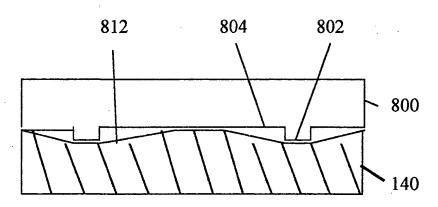


Fig. 12b

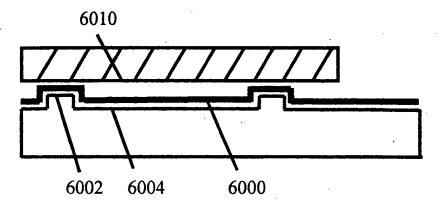


Figure 12c

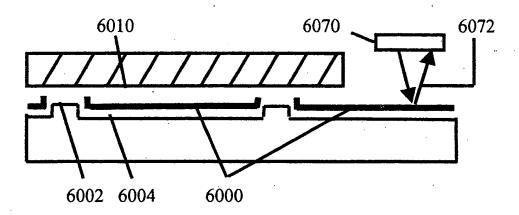


Figure 12d

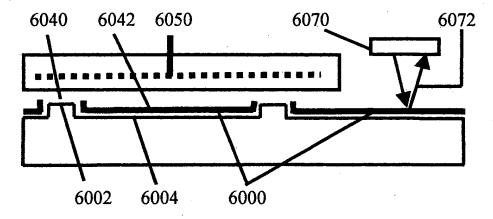


Figure 12e

Figure 13

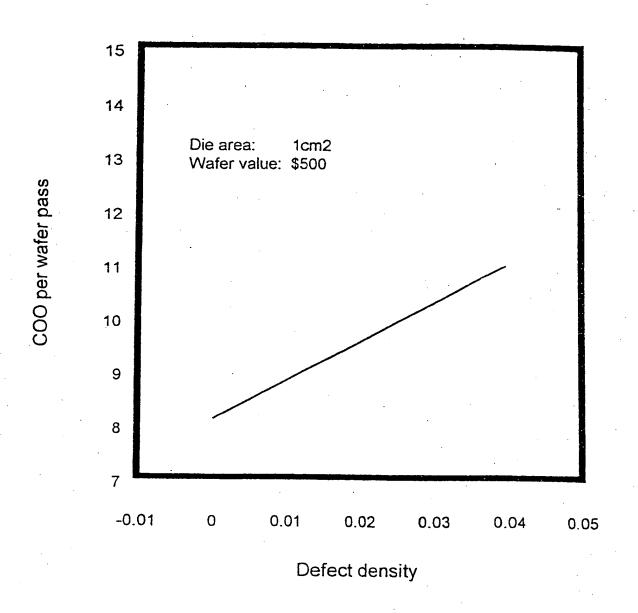


Figure 14

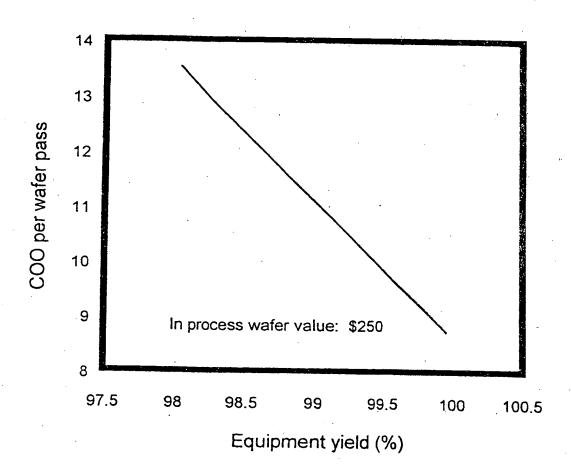


Figure 15

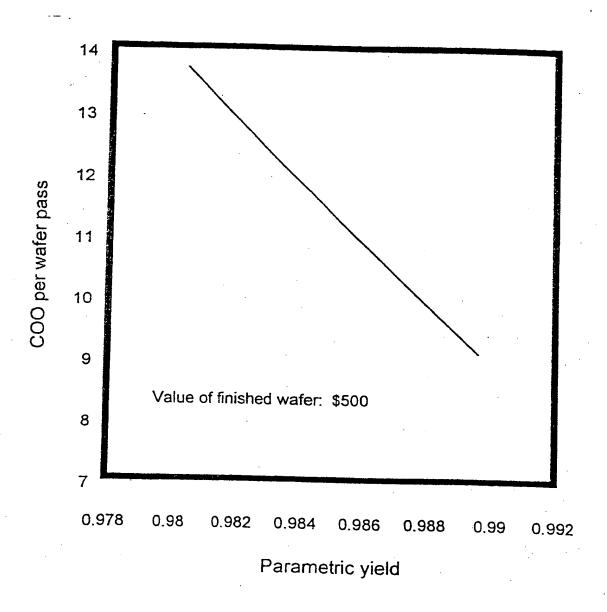
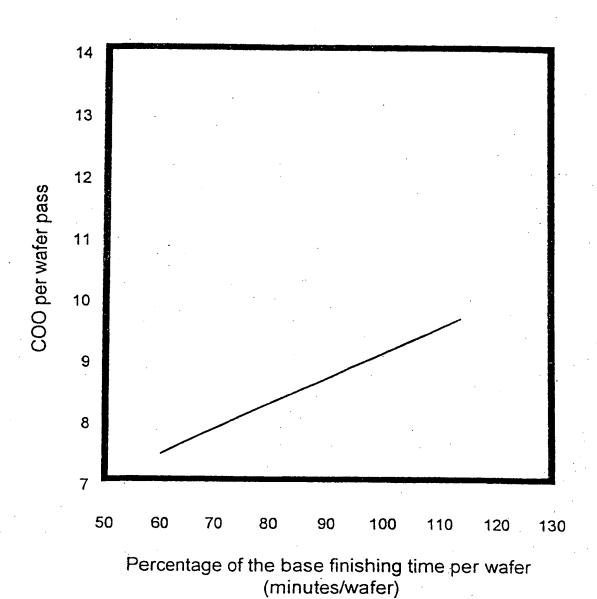


Figure 16



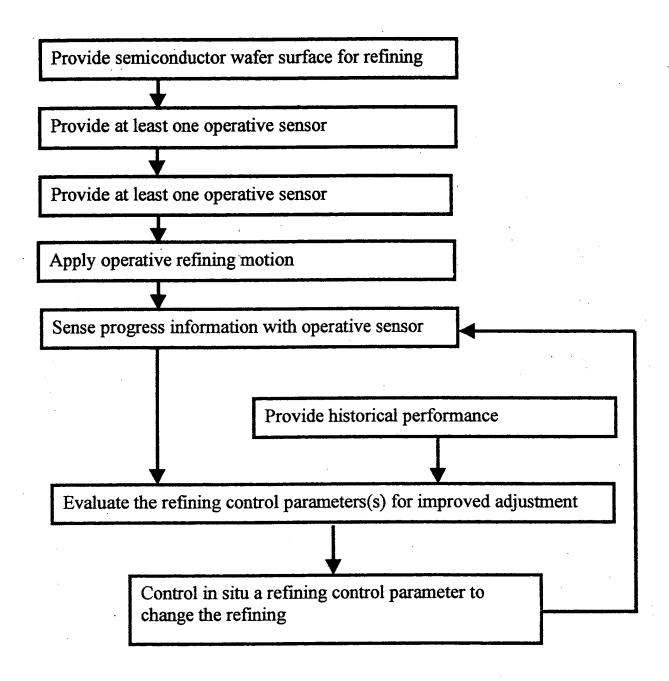


Figure 17

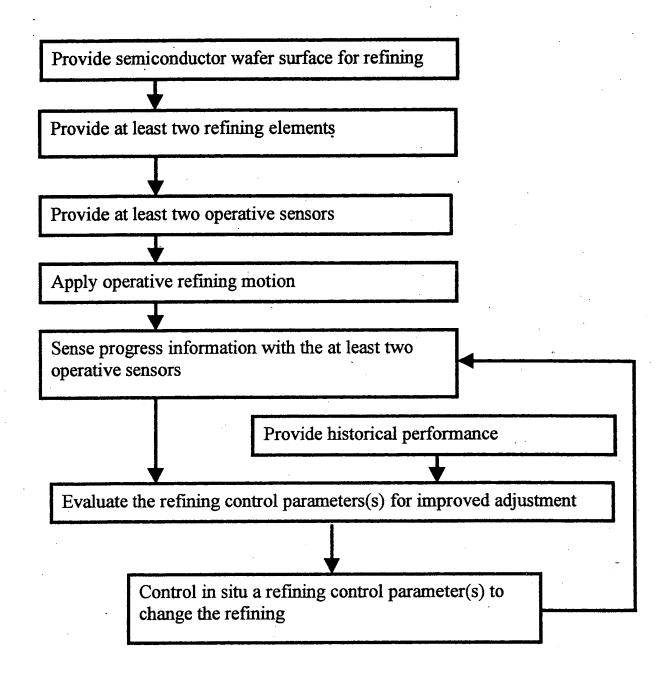


Figure 18

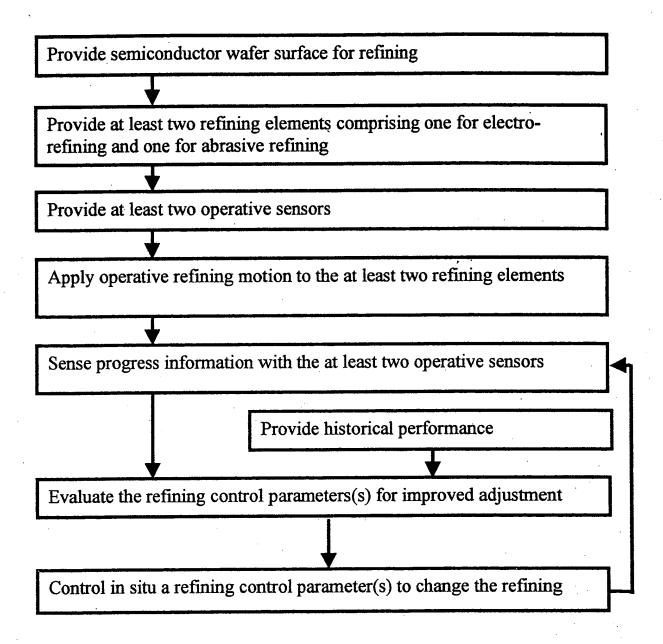


Figure 19

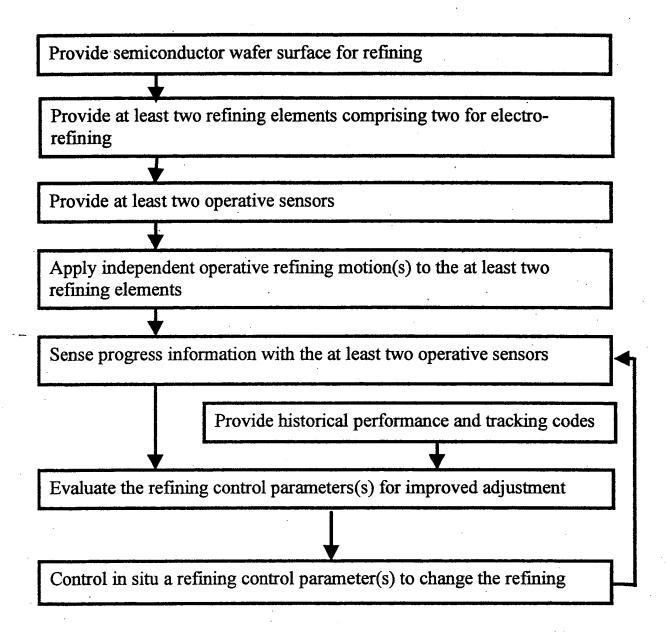


Figure 20

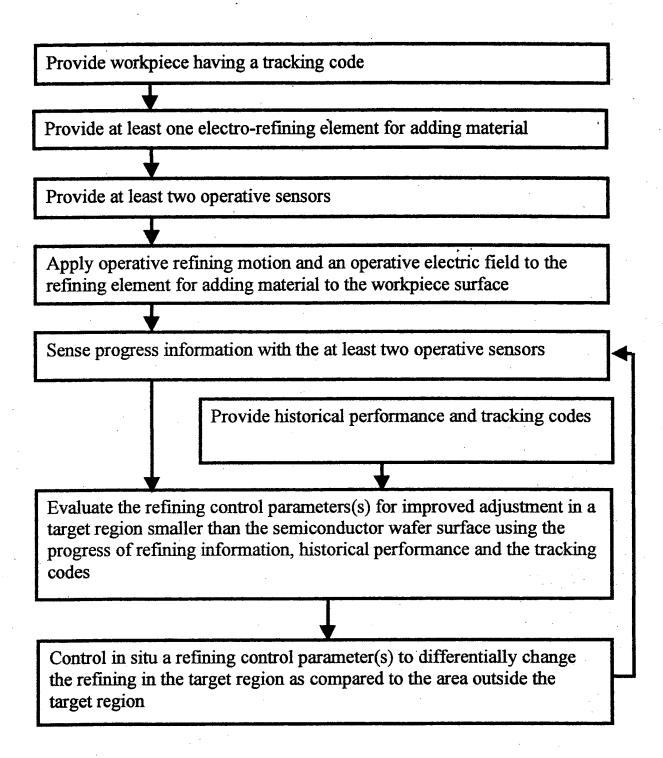


Figure 21

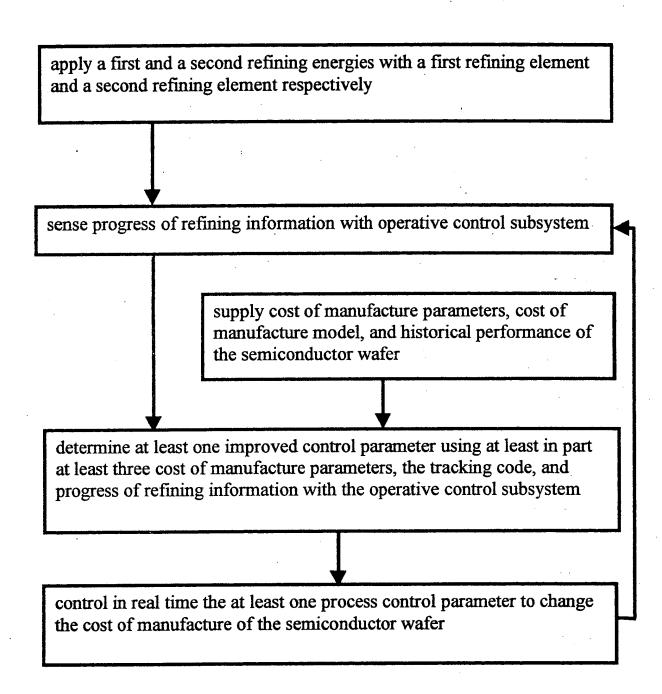


Figure 22

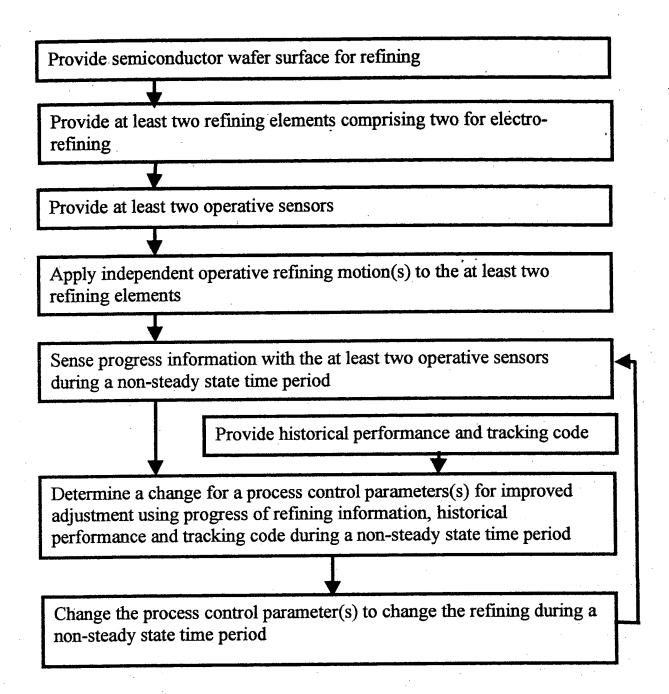


Figure 23

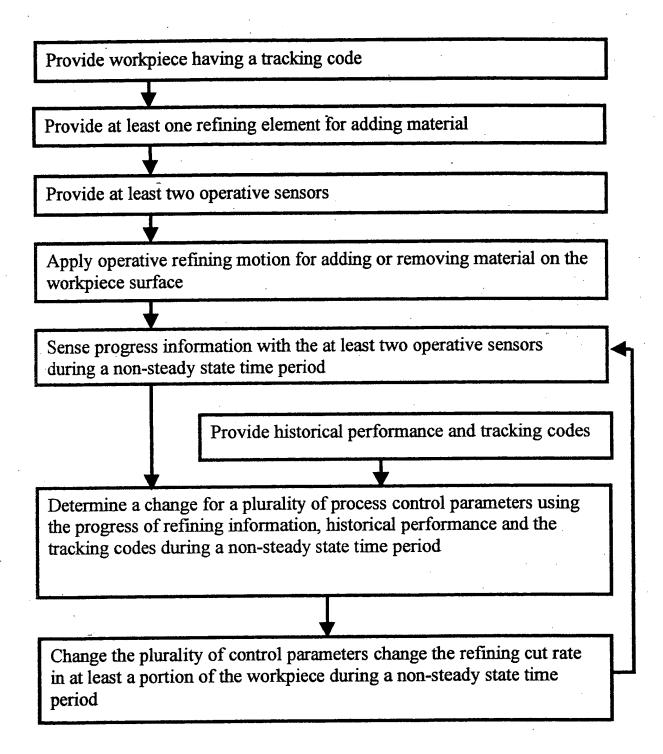


Figure 24

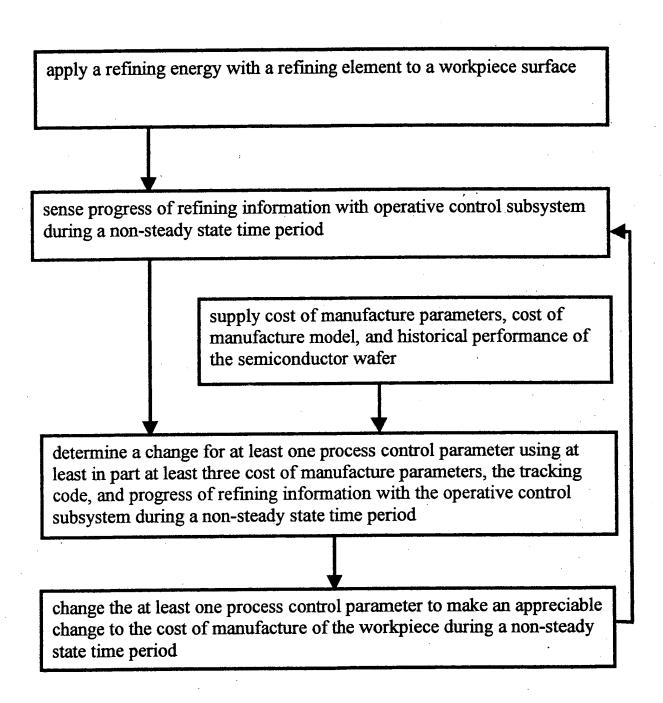


Figure 25

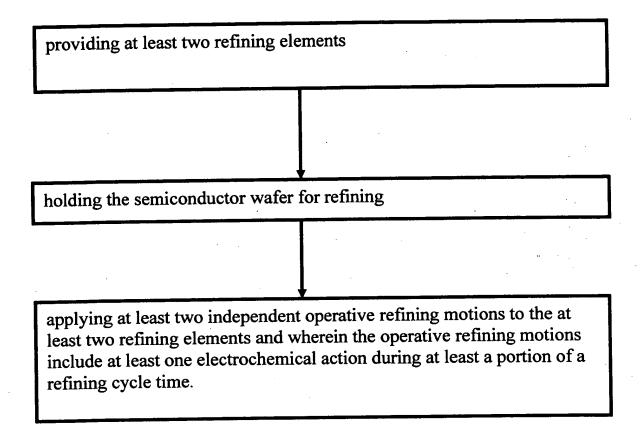


Figure 26

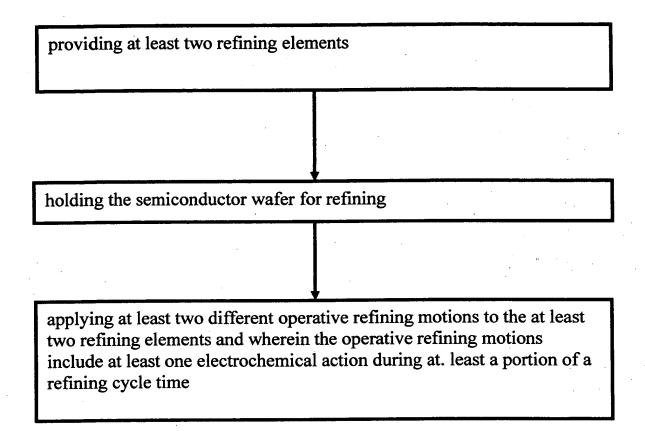


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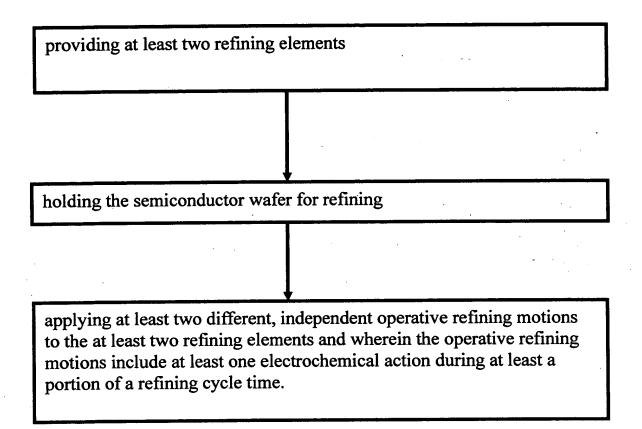


Figure 28

providing a refining element having a refining surface and having a first operative electrode

positioning the semiconductor wafer surface with a holder having an operative electrical contact forming a second operative electrode proximate to the refining element

applying an operative refining motion comprising a parallel operative refining motion in the interface between the semiconductor wafer surface being refined and the refining surface of the refining element

applying an operative voltage across the first operative electrode and the second operative electrode for electro-refining to remove the unwanted material on the semiconductor wafer surface during at least a portion of a refining cycle time

sensing progress information of the refining of the semiconductor wafer surface with an operative control subsystem having access to a process model and historical performance

determining at least one improved control parameter using at least in part at least the process model, the tracking code, historical performance, and the progress information with the operative control subsystem

controlling in real time the at least one process control parameter to change the refining

Figure 29

applying a refining energy to a workpiece with a refining element

providing an operative control subsystem having an operative sensor, a controller, and a processor and wherein the processor has access to (i) a process model, (ii) an assigned workpiece tracking code, and (iii) information in at least one memory device

sensing progress of refining information with the operative sensor during a period of non-steady refining

determining a change for at least one improved control parameter using at least in part at least (i) the process model, (ii) the assigned workpiece tracking code, (iii) the information in at least one memory device, and (iv) progress of refining information with the operative control subsystem during the period of non-steady refining

changing in real time the at least one process control parameter which changes the refining during the period of non-steady refining

Figure 30

applying a first refining energy to the first layer of the semiconductor wafer sensing a real time process information for the first layer of the semiconductor wafer with at least one operative sensor determining in real time at least one improved first layer control parameter "A" using a first tracking code and a real time progress information for the semiconductor wafer with an operative control subsystem having the at least one operative sensor controlling in real time the at least one first layer process control parameter "A" to change the semiconductor wafer surface during the refining of the first layer of the semiconductor wafer storing for future availability stored information related to the at least one first layer process control parameter "A", the first tracking code, and the real time progress information for the first layer refining sensing a real time process information for the second layer of the semiconductor wafer with the at least one operative sensor determining in real time at least one improved second layer control parameter "B" using at least a portion of the stored information related to the tracking code, the first layer progress information, and the second layer progress information of the semiconductor wafer with the operative control subsystem controlling in real time the at least one second layer process control parameter "B" to change the semiconductor wafer surface during the refining of the second layer of the semiconductor wafer

Figure 31